Spillage of material from overloaded haulage vehicles is a significant problem at many mines. If spillage is not prevented or if the material is allowed to remain on the haulage route, unnecessary bumps or mounds will exist. Therefore, every effort must be made at the loading point to prevent equipment from being heaped beyond the limit that can be held within the containing vessel.

During periods of dry weather, or in consistently dry environments, dust may become a problem, especially on gravel or crushed stone surfaces. To alleviate this situation, water trucks fitted with special sprinkler systems should be employed. If dust problems are severe, the operator should consider applying chemical additives. The incorporation of chloride salts with gravel or crushed stone surfaces will enhance moisture retention and eliminate the need for frequent road wetting.

Adherence to the preventive measures discussed can significantly reduce haulage road maintenance problems. However, they are not a complete solution. Abnormal surface conditions will occur periodically that require additional road maintenance procedures.

On more permanent surfaces such as asphaltic concrete, surface depressions should be corrected with asphaltic patches and either hand-tamped or rolled into place. When severe depressions occur on well-packed gravel surfaces, the surrounding area should be scarified, filled, and recompacted to an even consistency.

A motor grader should be used continually to maintain cross slopes, remove spills, and to fill and smooth surface depressions as they occur. Whenever the motor grader is used, care must be taken to avoid pushing waste into drainage facilities and the protective faces of safety berms. Accumulated material from the procedure should be removed to specially designated areas.

Ice and snow, whenever they occur, must be completely removed from the haulageway using a motor grader or other appropriate equipment. Special attention to the removal of snow and ice is required on asphaltic concrete and other smooth surfaces. The close-knit texture of these materials make them susceptible to rapid glazing in freezing weather. Consequently, they become slick and a definite hazard to vehicle controllability. Measures such as salting or cindering must be implemented immediately under these conditions.

All areas where loose material is employed to increase rolling resistance and vehicle retardation (escape lanes, median berms) should be periodically checked for loose consistency. If these areas become compacted, a bulldozer equipped with scarifying equipment should be used to break the surface.

VEHICLE MAINTENANCE CRITERIA

Mine haulage costs often represent up to 50% of total mining costs and sometimes as much as 25% of the overall operating, overhead, and other costs of the entire mining operation.[13] An item of this magnitude deserves, and generally gets, the major share of maintenance attention.

Most mining companies generally provide for regular, extensive maintenance inspections of their haulage vehicles. Some require daily inspection of such things as system pressures and integrity, tire pressure, fluid levels, electrical system continuity, belt tension, etc. Periodic maintenance (daily, weekly, or by hours of operation) is done to replace filters, change oil, grease fittings, clean air filters and breathers, clean and fill batteries, etc. Periodic inspection is required for brake systems pressure, brake linings, wheel bearings, cab controls and accessories, etc. Repair and replacement of components such as engine, transmission, rearend, axle, etc., is performed as required. Many companies require the truck drivers to file daily reports on vehicle condition. An example of a maintenance checklist is shown in the appendix.

During maintenance checks, special attention should be given to all brake system components to see that they are properly adjusted to manfacturer's specifications. A vehicle with improperly maintained service brakes, or pressure leakage in the brake components, which causes activation of the emergency brake system, could result in unequal brake application and excessive heating of one drum. Because ignition of brake system components and flame propagation to other truck areas is not uncommon, fire extinguishers have become standard equipment. In addition, improper adjustment of one or more linings places total dependence on the others. If uncorrected, the brakes that are functioning properly will experience excessive and unnecessary wear.

Although this checklist adequately covers those maintenance items that are to be checked on a 500-hour operating cycle, a daily log should be kept for each piece of equipment. This log book serves to record any difficulties or equipment anomalies experienced by each driver. Items that require repair or adjustment should be noted in the log book for the review of the next driver. If the maintenance item is of sufficient magnitude to affect the operating integrity of the equipment, a notation should be made in the log, and a notification filed with the maintenance foreman. Through this procedure, an operator starting the shift is made aware of the condition of the equipment and can check to see that repairs have been performed. After repairing any equipment malfunctions, the mechanic or electrician performing the work should be required to initial the log entry, and file an independent report to his foreman with a copy to the production foreman, if applicable. At the end of a specified period (1 to 2 weeks), the maintenance foreman should be required to review equipment log books to familiarize himself with minor problems being experienced by the operators. Log pages should be signed, dated, and filed within a master log kept for each piece of equipment.

Any equipment maintenance program must be governed by the individual operation. The foregoing example indicates how the responsibility for equipment. maintenance can be distributed to guarantee that adequate checks are conducted

[13] Burton, A. K. Off-Highway Trucks in the Mining Industry, Part I. Min. Eng., v. 27, 1975, pp. 28-34.

and responsive actions are taken. However, the ultimate responsibility for safe day-to-day operation of haulage equipment depends on the equipment operator. Since any deficiencies will affect safety, the driver should personally insure that his machinery functions properly before beginning work.

Every mining company should initiate a program to educate drivers in the performance of preoperational equipment checks. For most types of haulage equipment, a preoperational check will require no more than 15 to 20 minutes prior to each work shift. The preoperational check of machine components by the driver will be limited to items that are critical to safe operation, and the minimal time expenditure will be compensated by safer vehicle operation.

A general indication of the manner in which a driver's maintenance program can be conducted is delineated by SAE-recommended practice J153. However, the procedures set forth therein do not encompass the numerous component differences inherent to various types of large haulage vehicles. The precise manner in which preoperational checks should be conducted for each equipment type can be established through the manufacturer and maintenance foreman.

Following is a list of items that should be considered essential to an effective preoperational safety check. This list may or may not apply to specific equipment types and is not entirely comprehensive. However, it does illustrate a majority of the primary steps required.

I. Vehicle at rest--parking brakes engaged, wheels blocked

   A. Inspect visible body and chassis components for damage, integrity, and operation where applicable

      1. Windows

      2. Mirrors

      3. Wipers

      4. Lights (brake, parking, service drive, backup, and turn)

      5. Doors (cab and compartment access)

      6. Guards (component shrouds, electric cable insulation, etc.)

      7. Wheels and tires (tread, rock ejectors, lock rings, mounting lugs, and tire pressure)

      8. Steering (control arms and stabilizer bars)

      9. Suspension (shock and spring mounts)

      10. Control lines (hydraulic, pneumatic, mechanical cables, and electric cables)

11. Air tank moisture relief valves

12. Connections at dynamic brake grids

13. Face of engine radiator core

14. Seat and seatbelt mounts

B. Check all accessible reservoirs for proper fluid levels

1. Brake

2. Steering

3. Fuel

4. Radiator

5. Engine lubricant

6. Hydraulic retarder

7. Transmission

8. Batteries

C. Clean cab of all debris and secure tools, fire extinguisher, roadside flares, etc.

II. Engine running, transmission in neutral, parking brake engaged, wheels blocked

A. Inspect visible chassis components for leaks

1. Control lines (hydraulic, pneumatic, and electrical)

2. Air tanks

3. Hydraulic pumps

4. Air compressors

5. Exhaust transfer pipes

6. Coolant lines

7. Radiator(s)

8. Dynamic braking grid blower

B. Check operation of in-cab gages and controls

1. Temperature (oil and water)

2. Pressure (air and hydraulic)

3. Tachometer
4. Airflow-restriction indicators
5. Ammeter
6. Hydraulic servoacutators
7. Accelerator
8. Retarder
9. Service brake
10. Road-condition switch
11. All system engagement indicator lights
12. Steering
13. Horn
14. Backup warning
15. Engine shutdown
16. Emergency engine shutdown
17. Ground fault breaker

III. Vehicle in motion on level surface at low speed

A. Check for proper operation of primary controls

1. Steering
    a. Under power
    b. Engine off to insure integrity of emergency assist
2. Braking
    a. Retarder
    b. Service brakes under power
    c. Service brakes with engine off
3. Transmission

B. Listen for unusual noises

Any component faults detected by the operator during this type of inspection should be noted and reported immediately to the maintenance supervisor. The final determination as to the severity of a detected fault, and whether the equipment is or is not safe to operate, can best be determined by maintenance personnel.

RUNAWAY-VEHICLE SAFETY PROVISIONS

The large size of haulage vehicles precludes use of conventional vehicle arresting or impact attenuation devices to stop a runaway. In haulage operations with adverse grades, retarder failure has resulted in loss of life and substantial property damage. Some safety provisions should be incorporated into haulage road design to guard against the consequences of runaway vehicles.

The primary design consideration for runaway vehicle protection is the required spacing between protective provisions. If a runaway situation should occur, the driver must encounter a safety provision before his truck is traveling too fast to maneuver. The top speed at which the driver can maintain control (steering) of a particular vehicle is designated "maximum permissible vehicle speed." A single velocity could have been identified as the recommended maximum for all safety-provision entrances. However, the ultimate speed at which a driver can still maintain steerability and guidance of his vehicle varies according to manufacturer's design, road condition, and operator's experience. The speed to accept as a guiding criterion for the spacing of runaway protective devices can best be determined through a cooperative effort between the operators and management at each mine site.

On tables 13 and 14, distances between runaway-truck safety provisions are given for various road grades and maximum permissible velocities or terminal vehicle velocities. They apply to any type of runaway-protection device, and delineate the distance in feet required between safety-measure entrances for a truck to avoid exceeding the maximum permissible vehicle speed.

The tables illustrate differences in spacing requirements as they are affected by initial downgrade speed at the time total brake system failure occurs. Initial truck speed at loss of braking and retardation was assumed to be 20 mph for table 13 and 10 mph for table 14. Although operating speeds may vary considerably depending on policies at each mine, 10- and 20-mph initial velocities constitute a sufficient range for the grades given.